**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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| | : | National Phase of International App'l. No. PCT/DE2004/000801 |
| Applicant | | Ralf LERNER |
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| Title | : | MONITORING THE REDUCTION OF THICKNESS AS MATERIAL IS REMOVED FROM A WAFER COMPOSITE AND TEST STRUCTURE FOR MONITORING REMOVAL OF MATERIAL |
| TC/Art Unit | : | 2818 |
| Examiner: | : | Lopez Esquerra, Andres |
| Docket No. | : | 60291.000041 |
| Customer No. | : | **21967** |

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**REQUEST FOR PRE-APPEAL BRIEF CONFERENCE**

Pursuant to the Pre-Appeal Brief Conference Pilot Program announced in the Official Gazette and in response to the Final Office Action ("Office Action") mailed December 17, 2008, Applicants hereby request a pre-appeal brief conference in the above-referenced case. No amendments are being filed with this request. Additionally, this request is being filed with a Notice of Appeal.

Applicants respectfully request that the members of the Pre-Appeal Brief Conference ("Conference") allow all pending claims in view of the following remarks.

## THE REJECTIONS UNDER 35 U.S.C. § 103

### 1. The Rejections Based On Hsiao, So, and Hartmannsgruber Lack Merit

The Office Action on pages 2-8 rejects claims 1-24 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Pat. No. 6,515,826 to Hsiao et al. (Hsiao) in view U.S. Pat. No. 6,242,320 to So (So), and further in view of Hartmannsgruber, et al., "A Selective CMP Process for Stacked low-k'CVD Oxide Films", Microelectronic Engineering, Vol. 50, pg. 53-58, 2000 (Hartmannsgruber).

Applicant respectfully submits that this rejection lacks merit and should be withdrawn for at least the following three reasons. First, Hsiao is mischaracterized and improperly applied to claim recitations that it neither teaches nor suggests. Second, acknowledged deficiencies of Hsiao are not cured by either So or by Hartmannsgruber. Third, the Examiner has improperly imposed a "structural difference" requirement on a method claim. In view of Applicants' previously presented arguments and the arguments presented herein, claims 1-24 are allowable over the cited combination of Hsiao, So, and Hartmannsgruber.

#### a. Hsiao is mischaracterized and improperly applied to claim recitations

The office action at paragraph 4 provides a discussion of the Hsiao and the manner that Hsiao allegedly applies to various claim recitations.

In general response to the application of Hsiao to the claimed invention, Applicant respectfully submits that in Hsiao column 6, line 36 to column 8, line 24 and Figure 15, **no wafer pair** is shown that is bonded together. Figure 15 shows an aluminum layer 304, which is not a semiconductor wafer. This layer cannot be "removed", which would be needed when the top down representation of Figure 15 is bonded onto another wafer, to allow optical detection of reduction of thickness, by removing wafer material from the aluminum layer 304 downwards. Optical detection would also fail, because the two broadest trenches 332, 336 have the same width and reach down to the aluminum layer 304. They provide the same depth. The claim requires **a systematic row** of trenches and a reference trench that is neighboured by a shallower and a deeper trench. Trenches 332, 336 in Hsiao have the same width and the same depth. They cannot be used as a precise monitoring structure.

Paragraph 4 of the Office Action points to Figure 15 of Hsiao as allegedly showing a test structure. Applicant respectfully disagrees. There is no test structure shown and described, there is shown a structure that explains and visualizes the dependency of the RIE lag phenomena (*see* column 7, lines 29 to 35). The relationship between width and depth is shown. The test structure that is used for monitoring the thickness reduction in our method claim 1 is not explained in Hsiao, and the word test structure is nowhere used in Hsiao.

Paragraph 4(a) of the Office Action alleges that Hsiao discloses the claimed recitation of "said wafer receiving an active circuit ... in a later stage." Applicant respectfully submits that this active circuit is provided in the active wafer in the last paragraph of claim 1. The Office Action cannot properly compare the claimed "active circuit" to the two different types of putting electrical members into the opening 164, 168 of, for example, Figure 10 or Figure 11 in the corresponding trenches 172, 176 of different width, as shown in Hsiao. This is explained in column 5, line 40 to 44 of Hsiao where it is described that the coil openings and the electrical interconnect opening are treated differently and this is placed into the trenches. It follows that, in Hsiao, there is no *forming at least one active circuit in said active wafer in said later step* as presently claimed. This feature is neither disclosed nor suggested.

Paragraph 4(b) of the Office Action suggests that active wafer 300 (not 2) receives a removal action or a removal step. Applicant respectfully submits that no such removal step is shown from the aluminum layer 304, which would correspond Figure 2 and the top surface 2b in the present

application. When no removal action is there, the reference trench as assumed 350 about in the centre of the row of trenches in Figure 15 of Hsiao cannot be exposed, and therefore not optically detected. Thus, the feature of *performing the wafer material removal, commencing from a backside of the bonded active wafer until the reference trench is exposed, and optically detecting said exposure of the reference trench, for monitoring a thickness reduction of the active wafer* is neither disclosed nor suggested by Hsiao.

For at least these reasons, Applicant respectfully submits that Hsiao can not be properly applied to the claimed subject matter as presently alleged.

**b. So does not cure acknowledged deficiencies of Hsiao**

Paragraph 5 of the Office Action acknowledges the deficiencies of Hsiao. Specifically, the Office Action states that "Hsiao fails to teach the bonding of a carrier wafer after creating the trenches and the use of a polishing process on the backside of the active wafer made of silicon until exposing the reference trench."

Paragraph 6 of the Office Action introduces So and alleges that So cures the acknowledged deficiencies of Hsiao. Specifically, the Office Action relies on column 2, line 66 -- column 4, line 51 of So in conjunction with Figure 2G. Neither the cited portion of So nor So generally disclose or suggest *bonding the active wafer with a side which holds the test structure onto the second wafer of the semiconductor wafer pair* as is recited in independent claim 1.

The bonding of a carrier wafer is not shown. In fact, paragraph 5 of the Office Action has several deficiencies that have previously been identified in paragraph 4 of the action **to belong** to the teaching of Hsiao. The bonding is not shown in Hsiao. The active wafer is not bonded to a base wafer. This was addressed above. The use of a **removal process** from the backside is claimed in claim 1. It is termed to be a removal process. Hsiao does not remove anything through the aluminum layer 304 and it is said in 4(b) of the Office Action that a removal is there. In paragraph 5 the Office Action states that no polishing process from the backside (i.e. is the removal process from the backside of the active wafer) is present in Hsiao. The Examiner reverses his arguments between paragraphs 4 and 5. The exposing of the reference trench in paragraph 5 is also not shown in Hsiao, to the contrary in paragraph 4b is said that removal leads to an exposure of the reference trench 350, which is understood to be "to correspond to a depth of this reference trench 350". Paragraph 5 says this is not present in Hsiao, paragraph 4b says it is present. There are several deficiencies in paragraph 5 that the Office Action seeks to find in So.

Further, Paragraph 6 of the Office Action alleges that the plurality of different trenches has different depths 23, 24 in So. However, this is not what So describes. Figures 2A to 2I of So show **only two depths of trenches.** One is used as a first polishing stopper (*see* column 4, line 12). This is the higher (deeper) trench and the isolation layer 25 that is contained in this trench. The recited claim 1 teaches a systematic row of trenches and the systematic row is explained by the reference trench, at least, that is neighboured by a shallower and a deeper trench. Neither Figure 2G nor any of the other figures of So discloses this relation of a systematic row. The second trench depth 23 also filled with an isolation layer is also a polishing stopper (*see* So column 4, line 30). Two polishing steps are stopped at two trench depths. The result is shown in figure 2I of So. Therefore, in So, there is no teaching or suggestion of monitoring of thickness reduction using the systematic row of trenches and the certain definite depths recited in claim 1.

Further, paragraph 6(d) alleges that So teaches that removing is done from the backside of the active wafer. The removing taught by So stops at the two specified depths of the two different types of trenches that are filled with isolation layer, 23, 25. The claimed removal process ends at the targeted thickness after the end of the removing of material and is stopped when hitting the reference trench that has a neighboured other trench that is deeper and another neighboured trench that is

shallower. Paragraph 6(d) of the Office Action does not expose a reference trench as identified in the presently recited claim 1. Instead, it exposes the filling of a reference trench at the end of a polishing process, but not identifying another trench left and another trench right to this, one being already exposed and the other one not yet being exposed. The final paragraph of claim 1 recites that this exposure is then optically detected.

Paragraph 7 of the Office Action alleges that So provides evidence that a person of ordinary skill in the art would find a reason, suggestion, or motivation to combine the double wafer structure of So into the device of Figure 15 of Hsiao. Applicant respectfully disagrees. Hsiao cannot be removed or polished from the aluminum side 304. There is no motivation to combine matters that cannot function together. And still, no test structure is shown in Hsiao (and also not shown in So) so a further feature of "optically detecting the exposure of the reference trench for monitoring the thickness reduction" is not contained in both documents.

Paragraph 8 of the Office Action includes similar assertions to those presented in paragraph 7. For reasons discussed above, Applicant respectfully disagrees with the Office Action's conclusion that it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of Hsiao and So. So has no reference trench that is exposed, instead trenches are filled with isolating material, 23, 25, see column 4, line 10/12 and 33/34. The aim to have a "uniform semiconductor layer" as taught in So, column 4, line 35 to 37, is not found in Hsiao. Hsiao does not remove material and has a bar as aluminum layer 304. Nothing is fairly suggested to be combined, apart from hindsight combination of isolated features in prior art. The obviousness analysis presented in paragraph 8 of the Office Action is therefore unpersuasive and improper. For at least these reasons, the rejection under 35 U.S.C. § 103 should be withdrawn.

**c. Hartmannsgruber does not cure the acknowledged deficiencies of Hsiao and So**

Paragraph 9 of the Office Action acknowledges that neither Hsiao or So, when taken alone or in combination, disclose the use of an optical device in the claimed method.

The Office Action introduces Hartmannsgruber to cure this acknowledged deficiency. Applicant respectfully submits that Hartmannsgruber does not teach or fairly suggest using an optical detector. Instead, Hartmannsgruber suggests using a profilometer – which is not at all an optical device. Rather, it is a surface testing device by mechanical contact (*see* Hartmannsgruber abstract).

The device described in Hartmannsgruber would not be useful in the context described by So or Hsiao. In So, for example, the trenches are filled and therefore cannot be tested by a mechanical device. The exposed trenches 23, 25 in figure 2I have no surface difference with respect to the remaining active layer 21a. As a result, the device of Hartmannsgruber would be useless if placed in the environment of So.

Hartmannsgruber would also be useless in the context of Hsiao. More specifically, Hartmannsgruber would have no use in the context of Hsiao Figure 15 because there is nothing depicted in that Figure to be tested. The aluminum layer 304 is still solid and flat, and the other openings 312 simply define the ratio according to Figure 16 of width to depth of the trenches. These openings are not being used for monitoring a thickness reduction of the wafer as is recited in independent claim 1. It follows that the teachings of Hartmannsgruber, when added into the environment of Hsiao, do not result in *optically detecting said exposure of the reference trench, for monitoring a thickness reduction of the active wafer.*

In view of the above, it is clear that none of the Hsiao, So, or Hartmannsgruber references, when taken alone or in combination, disclose or even suggest the recited step of *performing the wafer material removal commencing from a backside of the bonded active wafer until the reference trench is exposed, and optically detecting said exposure of the reference trench, for monitoring a*

*thickness reduction of the active wafer.* For at least these reasons, the rejection under 35 U.S.C. § 103 is improper and should be withdrawn.

**d. Hartmannsgruber as additionally applied by an assumed of Hsaio and So does not teach or suggest all of the claim 1 recitations**

Hartmannsgruber as additionally applied by an assumed combination of Hsiao and So still fails to teach or even suggest all of the claim 1 recitations. It would not have been obvious to one of ordinary skill in the art at the time of the invention to combine Hsiao and So. Figure 15 of Hsiao shows trenches of different width and depth, with the width of the trench being proportional to the depth of the trench. So, on the other hand, (*see* Figure 2F) shows trenches with the same width and different depth. In other words, the depth of the trenches in So is not proportional to the width of the trenches.

Further, So shows the trenches in an upside-down orientation from that which is shown in Hsiao. To combine So with Hsiao would result in trenches bonded in an upside-down orientation, and the trenches would have widths not proportional to the depths. Thus, the alleged combination changes the principle mode of operation of Hsiao. A person having ordinary skill in the art would have no reason to make such a combination, and, in fact, the references teach away from a combination with one another.

In view of the above, one would have to employ hindsight reasoning to commence a material removal from the top (layer 304 of Hsiao) assumed to be turned upside down. This layer is non-etchable material (*see* Hsiao column 6, lines 61 to 66).

Further it is not shown by Hartmannsgruber that an optical detection of the exposure of the bottom of the reference trench is taking place. This is a method claim. And if hindsight reasoning is relied upon in the combination of Hsiao and So and then Hartmannsgrubber is additionally combined, such a combined system does not teach or even suggest all of the claim 1 recitations.

**e. The Office Action improperly concludes that certain claimed recitations do not carry weight**

Paragraph 13 of the Office Action states the following:

> *Also, as for the limitation of "said active wafer provided for receiving an active circuit in a later step" (claim 1) recitation of the claimed invention does not result in a structural difference between the claimed invention and the prior art, thus claimed invention is only an art recognized suitability for an intended purpose, MPEP 2144.07.*

Paragraph 16 similarly recites the following:

> *Finally, a recitation of "said first wafer for receiving an active circuit in a later stage" and "for monitoring the reduction in thickness of the claimed invention does not result in a structural difference between the claimed invention and the prior art, thus claimed invention is only an art recognized suitability for an intended purpose, MPEP 2144.07.*

The non-final office action of May 27, 2008 also included the above recitations. In the November 6, 2008 response to the non-final office action, Applicant respectfully requested clarification on how the alleged lack of a structural difference between the claimed invention and the prior art -- and, indeed, MPEP § 2144.07 as a whole -- are in any way relevant to the patentability of claim 1.

The Office Action provides no further elaboration. The text of the non-final office action is simply repeated in the Office Action. The Examiner does not provide any further explanation as to why the claimed functional language is not given any weight.

Applicant respectfully emphasizes that claim 1 recites **a method** of manufacturing. The method needs method steps to distinguish. The method steps may work or operate structure, but they do not necessarily need structure to distinguish.

The Examiner's attention is respectfully directed to the last feature recited in claim 1, which recites *forming at least one active circuit in said active wafer in said later step.* The active wafer is one of the two wafers that form the bonded pair of wafers (see lines 1 to 3 of claim 1 and the final paragraph of claim 1). Applicant respectfully submits that the claimed invention therefore recites a distinguishing method step.

Further, Applicant respectfully submits that the claimed feature of *optically detecting said exposure of the reference trench* is an additional recitation of the claimed method that is neither taught nor suggested by the combination of references cited in the Office Action. This is an optical step to detect the exposure of a trench that has substantially a depth that corresponds to the targeted thickness of the active wafer. Again, applicant respectfully submits that in this respect the claimed invention recites a distinguishing method step. The Examiner has not fully considered either of these recitations and attempts to justify such an interpretation on the basis of structural difference. Applicant respectfully submits that this interpretation is improper, that all the claimed recitations carry patentable weight, and that the rejection to the claims should therefore be withdrawn.

## 2. Independent claims 10 and 24 are also allowable over the cited references

Claim 10 is allowable for reasons similar to those described above. The claimed device for monitoring contains the test structure and has the systematic row, having at least the reference trench in it. The "different width in a defined manner" suggests that there are different depths of the trenches, as given in figure 16 of Hsiao, where the relation of depth and width is shown. The removal process in claim 10 exposes the reference trench. It exposes the bottom end of the reference trench by removing the bottom, which actually makes the reference trench exposed. This is done in the systematic row of a plurality of trenches, each one having a different width – which is now clarified in the first paragraph of the body of claim 10.

Further, claim 10 recites the first wafer structurally to include an active circuit. This is a structural difference against at least Hsiao. And So does not teach or fairly suggest using reference trench as recited in the final paragraph of the claim to define the target thickness of the removal process. The bottom of the trench is also not exposed in So as those trenches are filled with insulation material. With respect to claim 11, only the insulation material can be exposed, but not the empty trench that has nothing in it.

The same applies to claim 24. This method claim has several steps and the exposure of the reference trench is the monitoring of the thickness reduction. Claim 24 recites wafers as active wafers and carrier wafers. The claim also recites reduction monitoring during the production of a bonded pair of semiconductor wafers. Additionally, the final paragraph of claim 24 recites that several neighbouring trenches on one side of the reference trench and several other neighbouring trenches on the other side have certain depths. One set of trenches is deeper and the other set is shallower. The cited prior art references do not teach or suggest such a method.

Claim 24 is allowable for at least these reasons and also for similar reasons described above with respect to claim 1.

## CONCLUSION

Accordingly, rather than proceeding with an expensive appeal, Applicants respectfully request that the Office either refine its position or indicate its intention to allow an appeal to proceed.

As a result, an appeal on that basis will certainly succeed, but the time and expense in preparing an appeal brief on that issue should not be borne by Applicants when the grounds provided in the Office Action are so clearly improper.

Respectfully submitted,
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